A New Fourier Transform Microwave Spectrometer Designed to Study Interstellar Molecules of Biological Relevance

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For the past 35 years, the interdisciplinary synergy between gas-phase laboratory molecular spectroscopy and radio astronomy has revealed a rich organic chemistry in the interstellar gas, which is exceptionally complex towards active star-forming regions. New solar systems with an abundant organic component condense out of this gas and may influence the creation of life on newly formed planets. Much of the biologically important functionality is present among the some 130 gas-phase molecules found to date, including alcohols, aldehydes, ketones, acids, amines, amides and even the simplest sugar—glycolaldehyde. Still, many unidentified interstellar radio signals remain, and their identification relies on further laboratory study.

A new Fourier transform microwave spectrometer has been constructed as part of the Life and Planets Astrobiology Center (LAPLACE) initiative. This spectrometer is tailored to study potentially important biological precursor molecules that may have played an important role in the evolution of life on Earth and elsewhere in the galaxy. The basic components of this system are a vacuum chamber equipped with a high-finesse Fabry-Perot cavity, a medium power microwave transmitter, a low-noise heterodyne detector and a supersonic molecular beam nozzle. Rest frequencies of candidate molecules measured in this system will be used for subsequent searches in the interstellar medium using radio telescopes.